In presenting this dissertation as a partial fulfillment of the requirements for an advanced degree from the Georgia Institute of Technology, I agree that the Library of the Institution shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to copy from, or to publish from, this dissertation may be granted by the professor under whose direction it was written, or when such copying or publication is solely for scholarly purposes and does not involve potential financial gain. It is understood that any copying from, or publication of, this dissertation which involves potential financial gain will not be allowed without written permission.

Lesil Spartan Bomar, Junior

A STUDY OF THE PHYSICAL PROPERTIES OF KNITTED FABRICS MADE FROM VICARA-NYLON BLENDS

A THESIS

Presented to

the Faculty of the Graduate Division

Georgia Institute of Technology

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Textiles

By

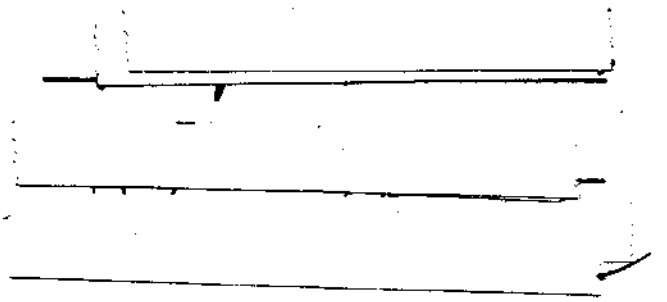
Lesil Spartan Bomar, Junior

March 1956

+.2
12T

A STUDY OF THE PHYSICAL PROPERTIES OF KNITTED FABRICS MADE FROM VICARA-NYLON BLENDS

Approved:



Date Approved by Chairman: March 16, 1956

ACKNOWLEDGMENTS

On the completion of this study, I wish to express sincere thanks to the following individuals and organizations. First, deep appreciation is extended to the Quartermaster Corps of the United States Army under whose sponsorship this graduate study was made possible. Sincere thanks is also expressed to Mr. R. L. Hill and Dr. J. L. Taylor of the Georgia Institute of Technology for their valuable guidance, patience and understanding.

Also, I would like to express my thanks to the E. I. du Pont de Nemours and Company and Industrial Rayon Corporation for their generous contributions of nylon staple; to the Virginia-Carolina Chemical Corporation for their contribution of Vicara staple; and to the Holeproof Hosiery Company of Marietta, Georgia, for contributing the use of their machinery, materials and personnel to assist in the manufacture of the knitted fabrics.

And, finally, I give my sincerest thanks to the many students and faculty members of this institution who so patiently donated their time and efforts to make possible the wear test for this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

SUMMARY

The blending of fibers to produce fabrics that will possess a desired set of characteristics is one of the most important phases of the textile industry today. All textile fibers have good features but generally lack certain other properties desirable in a finished product. With the many synthetic fibers available now, most any set of characteristics is within reach by proper blending procedures. The object of this study was to determine the physical properties of Vicara and nylon blends, to determine whether or not they would give a knitted fabric suitable for footwear and, if so, what range of blends would give the best combination of the desired properties.

The Vicara and nylon fibers were processed into yarns having the following blends: 75/25 Vicara/nylon; 62.5/37.5 Vicara/nylon; 50/50 Vicara/nylon; 37.5/62.5 Vicara/nylon; 25/75 Vicara/nylon; and into 100 per cent Vicara and 100 per cent nylon. All yarns were knitted into hose of like construction in so far as possible.

Tests were made on the stock at every stage of production from the card sliver to the plied yarn to determine the running quality of each lot. Tests were made on the finished hose to determine abrasion resistance, bursting strength and moisture content. In addition, wear tests were conducted to give practical determinations of softness, warmth, absorbency, pilling, abrasion and appearance.

No adverse running quality was observed during the processing of any of the stock. It was established that a desirable fabric for footwear

was obtained with blends containing from 37.5 to 50 per cent Vicara. This range of blends gives adequate abrasion resistance and bursting strength along with good moisture absorbency, softness, warmth and appearance.

It is recommended that fabrics be made from yarns of different blends, sizes and twists to explore the possibilities of making a better fabric for this end product.

CHAPTER I

INTRODUCTION

Today, with the higher standards of living and increased time for leisure, there is a greater demand for new fabrics that will provide the varied properties required by the consumer (1). The art of blending has long been recognized as a means of economizing and, more important, as a way of contributing some desirable characteristic or quality to the end product.

Long before man-made fibers were introduced, fibers were blended to obtain certain results. For instance, cotton of slightly different qualities was and still is blended to get a more uniform product or to cover up some differences which may exist between any two or more bales. The blending of wools attains certain desired characteristics of appearance or hand which would probably be impossible to get by using any single type. Likewise, man-made fibers offer like opportunities for objective blending (2).

Mr. Jesse F. Yeates, Jr., of the Virginia-Carolina Chemical Corporation is quoted as follows (3):

> The introduction of new and different man-made fibers and great progress in the art of blending fibers have combined to create vast new opportunities for fabric development. It is no longer necessary to limit a fabric to the qualities and characteristics of a single fiber. Today, the art of blending is using fibers to supplement and complement each other, thus providing fabrics with extra advantages. Fabric development experts have discovered that two or more fibers are often better than one, in enhancing the quality, beauty, comfort, value and wearability of the fabric.

Two fibers which possess many very desirable properties are Vicara and nylon. But it is unfortunate that each of these fibers does not possess all of the combined properties of the two. This would indeed be a fiber of unheralded demand for unlimited end uses!

Textile research has shown that the hydrophobic and the hydrophilic fibers are complementary to each other. Hydrophobic fibers are ones that are water insensitive and nylon falls into this class. Hydrophilic fibers are water sensitive. Vicara stands high in this category, competing very favorably with wool (4).

"The significant properties of nylon are its excellent resistance to abrasion, high elastic recovery, low resistance to stretching and bending, and resistance to alkalies." (5) The specific gravity of nylon is 1.14, remarkably low among textile fibers. The water absorption of nylon is 6.1 per cent at 95 per cent relative humidity, very low among textile fibers (6).

Vicara is made from zein, the protein from corn. It is similar to wool in resilience (at 65 per cent relative humidity), handle, warmth, moisture absorption, heat of wetting and combustibility (7). It has a moisture absorbency of 18 per cent at 95 per cent relative humidity and has a specific gravity of 1.25. Vicara is inherently moth resistant, highly mildew resistant and is not affected by age (8). The high moisture absorption and heat of wetting that Vicara possesses contributes to the warmth and comfort during wear of fabrics made from this fiber.

The blending of nylon and Vicara is an excellent example of combining many desirable properties to produce an end product of great

potentialities. Toward this end is the practical application of this study.

The Problem.—The object of this study was to determine the physical properties of knitted fabrics made from various blends of nylon and Vicara and to evaluate these results in order to find which blends would give the best combination for the many desirable properties.

The amount of work done along this line, or at least that which has been published, is almost negligible. Blends have been made from these two fibers and are now being used in various types of fabircs (9). However, it is not the object of this study to merely concur that these blends can be used, but rather to determine the physical properties of each and to isolate the best range of blends for the particular fabric being tested; i.e., men's hose. In order to do this realistically several important factors must be kept in mind concerning this article of wear. Of all the various garments worn by man, there is perhaps none that take more constant hard wear than hose. At the same time, the foot is one of the most important parts of the body and proper care and attention is imperative for good hygiene. A hose with proper characteristics for comfort is very important. Thus, adequate abrasion resistance and bursting strength is necessary along with good absorption, softness and warmth. Neither of the two fibers in this study has all these properties by itself.

The Approach.—In order to get results which could be compared, there had to be similar fabrics made from each blend. Five blends of Vicara and nylon were proposed along with 100 per cent Vicara and 100 per cent

nylon for comparison and as a control.

Since the yarns needed to manufacture the hose were not available, they had to be made. In order to reduce the variables in the yarn processing, it was planned to use the same machines, processes, settings, drafts and controls except for minor changes which might become necessary. Good results could be expected in the yarn processing since both the nylon and Vicara were of the same denier and staple length and their specific gravities are very close.

The hose for this study were made in a hosiery mill under the standard prevailing conditions. They were made on standard machinery and subjected to the normal requirements and inspections of the mill. The hose were knitted, looped, inspected, pre-boarded, scoured, dyed and boarded so that the finished product would be representative of that which goes to the consumer.

Tests were performed during the processing of the yarn as well as on the finished fabrics. At each stage of production, from the card sliver to the plied yarn, Uster evenness tests were made to detect any variation in the running quality of the different lots. The tests made on the finished fabrics were standard tests for abrasion, bursting strength in the heel and toe, and moisture absorbency. In addition to the above tests, an actual wear test was conducted which gave practical and realistic information which could not have been obtained by any other means. Included here are such properties as warmth, softness and appearance.

CHAPTER II

INSTRUMENTATION AND EQUIPMENT

All the machinery used for processing the fibers into yarn was the standard equipment found in the A. French Textile School Laboratories. The opening equipment consisted of a Whitin combination one process Picker Model T, 1949, with a feed hopper in tandem with a blending hopper, Model K-6, 1949. The fan used for this equipment was a Number 4 Sturtevant fan which exhausted into a Saco Lowell Model Number 7 Filter.

The card used was a Saco Lowell Roller Top Card, Model 1, 1948. It was clothed with standard clothing of 90's on the cylinder and 100's on the doffer. The workers and strippers were clothed with metallic type clothing. A Whitin four-roll Drawing Frame, Model L2FS, 1949, was used for drawing. All the rolls were fluted, metallic rolls. The roving equipment was a Saco Lowell 10 x 5 Intermediate, Model 1948, equipped with FS-1 drafting unit. Spinning was done on a Saco Lowell Model 1948, four-inch gauge, two and one-quarter inch diameter ring, equipped with a Shaw System SS2 drafting unit, New Era Spindles and Pneumafil attachment. The twister used was a Whitin, Model B, 1934, three and one-half inch gauge and two and one-half inch ring diameter. The yarn was coned on a Universal, Number 50, Spindle Winder.

Knitting was done on a Scott and Williams Komet, 132 needle, 24 gauge, four inch cylinder, running 100 R. P. M. A Sotco Steady

Dial Looper, 14 points per inch, 300 stitches per minute was used. Dyeing was done in a vat used by the dye laboratory for experimental dyeing.

Abrasion tests were conducted on a Custom Scientific Instruments, Incorporated, Stoll Quartermaster Universal wear tester.

The bursting strength tests were made on a Scott Model J2 tester using a Ball Burst Tester, Model W, with a 0-300 pound capacity dial.

A Brabender Corporation semi-automatic moisture tester, type FD, was used to measure the per cent moisture absorbency on each lot of material.

CHAPTER III

PROCEDURE

The raw stock used for this study was nylon staple, semi-dull, three denier, one and one-half inch staple length, type 200 and Vicara staple, dull bleached, hi-crimp, three denier, one and one-half inch staple length, code 10-337-6.

As was mentioned earlier, every endeavor was made in this study to process each lot of materials in like manner. All lots of yarn were processed under the same atmospheric conditions of temperature and relative humidity. The drafts, doublings, machine settings and the sizes of the material fed and delivered remained the same in so far as possible. The only exceptions to this will be discussed in the procedure as they occur. Before proceeding further, the following organization of weights and drafts is presented.

Table 1. Organization of Weights and Drafts

Machine	Draft	Doublings	Size
Picker	4	4	15 oz.
Card	109	1	60 gr.
Drawing Frame	6	6	60 gr.
Roving Frame	13.5	1	1.85 hr.
Spinning Frame	16	2	15's
Twist Multipliers	2.75 (Z twist on spun yarn-10.5 T.P.I.)		
	2.75 (S twist on plied yarn-6.5 T.P.I.)		

To carry out this study, seven lots of yarn had to be made. 100 per cent Vicara and 100 per cent nylon lots were made for comparison and as a control. Between these two extremes were five blends: 75/25 Vicara/nylon; 62.5/37.5 Vicara/nylon; 50/50 Vicara/nylon; 37.5/62.5 Vicara/nylon; and, 25/75 Vicara/nylon.

The raw stock was first allowed to condition in the picker room at 80 degrees Fahrenheit and 65 per cent relative humidity. It was decided that more uniform and even blends could be produced by blending equal weight laps in various combinations on a finisher picker. A finisher picker is designed to take four laps in the creel, feed them uniformly to the beater, and reform them into one lap at the delivery end of the machine. Thus, the Vicara and nylon were run separately through the feed hopper, thence to the blending hopper and formed into equal weight laps. These laps were then placed in the creel of the finisher picker in varying combinations; e. g., when one lap of nylon together with three laps of Vicara were fed simultaneously to the beater section with a draft of four, the result was a blend of 75/25 Vicara/ nylon. The other blends which varied by quarter increments were made by varying the laps in the creel in similar manner. The two remaining blends were made utilizing a blend that had already been processed, e. g., two laps of 100 per cent nylon together with two laps of 75/25 Vicara/nylon resulted in a finished lap of 37.5/62.5 Vicara/nylon. The 62.5/37.5 Vicara/nylon lap was made similarly by using laps of the reverse percentages. One finisher lap of each of the seven lots of material was made to be fed to the card. Operating speeds and settings are shown in Table 4.

The finisher laps weighing 15 ounces per linear yard were carded one at a time on the roller top card. The first lap run was the 100 per cent nylon, and this was followed in order by the laps with decreasing percentages of nylon until all the laps were run. The cylinder and doffer were stripped after each lot was run to prevent any remaining fibers from getting into the next lot. The only difficulty resulted when the 100 per cent Vicara sliver sagged between the calender rolls and the coiler rolls due to the Vicara being open and fluffy. A larger size of trumpet was placed at the coiler rolls eliminating this trouble. Otherwise, no difficulty was observed and all of the material carded well. Operating data for the card is shown in Table 5.

The card sliver made from each lap, weighing 60 grains per yard, was collected into six sliver cans containing equal amounts. Each set of six cans was fed into one delivery of the drawing frame and drafted, with a draft of six, into one end weighing 60 grains per yard. This was collected into six cans and the process was repeated for the second drawing. The roll settings remained the same for all lots as shown in the operating data in Table 6.

Thus far in the processing no trouble was encountered due to static electricity or running quality of the materials. Atmospheric conditions during picking, carding and drawing were kept constant at 80 degrees Fahrenheit and 65 per cent relative humidity.

Each end of twice-drawn sliver was processed separately on the intermediate roving frame. Operating data is shown in Table 7. The roving formed from the sliver was wound onto six bobbins for each lot. One minor change had to be made on the roving frame in order to run

the 100 per cent nylon lot. Nylon fibers lie closer together than Vicara fibers becuase they are not as fluffy. Because of this the 100 per cent nylon roving, although of the same weight per unit length as the other lots, had a slightly smaller diameter. Therefore, the tension gear had to be changed when this lot was run in order to keep the roving from sagging onto the flyer and breaking out.

Each lot of roving was double creeled on the spinning frame and processed through the Shaw drafting system. The builder motion was arranged for filling wind and "Z" twist imparted into the yarn. The traveler weights had to be varied for different lots in order to obtain correct running conditions (Table 8). Each end of yarn was spun and tested until the desired size and twist was obtained by changing the draft and twist change gears. Two doffs were run for each lot and marked for identification and for doff number. The roving bobbins in the creel were alternated within each lot so that the same ones would not be together and the pairs of bobbins changed so that they would feed to different positions on the spinning frame. Then two more doffs were run and likewise marked. By changing the roving bobbins in this manner, six different positions on the frame were used for each lot, thus averaging out any differences which might occur in the running quality of the separate drafting units and spindles.

For each lot of yarn, bobbins were double creeled on the twister making sure that no two bobbins from the same spindle or doff number were creeled together. The correct amount of "S" twist was obtained by changing the twist change gear. The plied yarn was then wound onto cones to be used on the knitting machine.

The product of each process from the picker through the twister were sized to determine its weight; in the case of picker laps, three determinations per lot were made on one-yard lengths; in the case of card and drawing slivers, six determinations per lot of one-yard lengths were made; for roving, six determinations per lot of 12-yard lengths; and, for yarns, six determinations per lot of 120-yard lengths were made.

All slivers, roving and yarns were tested for uniformity on a Zellweger, Limited, Model B Uster tester with chart recorder. Speeds used were four yards per minute for slivers and roving and eight yards per minute for yarns. Lengths tested were as follows:

Card sliver and drawing sliver	30 yards per lot
Roving	20 yards per lot
Yarn (singles)	90 yards per lot
Yarn (plied)	30 yards per lot

The range variation per yard for each lot is shown in Tables 9 through 20.

Each lot of the finished yarn was knitted separately on the same machine into 9 x 6 English Rib hose. Test hose from each lot were checked to meet the following conditions: Size-11; length of top-12 inches; stretch in top-8 inches. All lots of the yarn ran well on the machine. The stitch had to be loosened slightly for the lots which contained 62.5 per cent or more Vicara in order for these hose to board properly to size 11. Each hose was marked so that it could be identified properly through the finishing operations. The hose were looped and

inspected according to mill standards. Before dyeing, the hose were placed on forms and pre-boarded in a steam cabinet for three minutes at 240 degrees Fahrenheit.

All lots of hose were dyed using the following procedure and dye formula. The hose were scoured in one per cent Dupanol D for 10 minutes at 140 degrees Fahrenheit. The hose were immersed in a cold bath and the following dye formula was slowly added:

1 per cent Igepal
10 per cent Glauber Salt
0.6 per cent Chromacyl Blue GG
0.3 per cent Chromacyl Orange R
0.25 per cent Chromacyl Pink BN

The temperature of the bath was slowly raised to 180 degrees Fahrenheit and kept at that temperature for 30 minutes. At the end of this time 0.5 per cent sulfuric acid was very slowly added to the bath. The dyeing was continued until the bath had exhausted to the limit. The hose were then rinsed and treated in a 3 per cent solution of Millisan at 110 degrees Fahrenheit for 10 minutes to impart a softness to the fabric. It was interesting to note that, although the dye formula used was represented as one that would give a good union with these two fibers, this was not the case. The dye exhausted more easily and in greater quantity on the nylon giving it a darker color than the Vicara. This proved to be very desirable during the wear testing of the fabric since it could be readily detected how each of the fibers was being affected. The last finishing operation was boarding the hose on size 11 forms for two minutes at 260 degrees Fahrenheit.

It was noted from experience and observation that the part of a hose that bears the brunt of rubbing, or abrasion, is that part of the leg just above the heel. Therefore, the leg of the hose was selected to be subjected to the abrasion test. Operation of the tester was in accordance with the bulletin published by the manufacturer using three pounds pressure on the diaphragm and one-half pound weight loaded on the balanced head. The surface abrasion head was engaged rotating the test specimen one turn per 100 cycles of the reciprocating table. Number "0" emergy paper was used as an abrasive. The instrument was automatically stopped when the test specimen had been abraded sufficiently to allow the contact points in the diaphragm and the balanced head to complete an electric current. The cycles to destruction was then read from the counter. Ten test samples from each lot of material were tested in conformance with ASTM standards (10). Table 19 shows the average cycles necessary to destroy the materials.

The bursting strength tests were conducted on the hose using a constant-rate-of-traverse machine equipped with a ball bursting attachment as prescribed by ASTM standards (11). Ten tests were made in both the heel and the toe of the hose. The average bursting strength for each lot of material is recorded in Table 20.

The tests for moisture content, or absorbency, was conducted using a Brabender semi-automatic moisture tester which has a built-in weighing apparatus which indicates the moisture content on a scale. Other than using this special instrument, the tests were conducted in accordance with Federal Specifications CCC-T-191b, method 2600 (12).

Two samples from each lot of materials, weighing exactly 10 grams when conditioned, were used. Each sample was placed in the weighing basket and dried to a constant weight. The per cent moisture content was then read directly from the scale. Table 21 shows the average moisture content for each lot of material.

The above tests were made in the physical testing laboratory which was conditioned to a standard atmosphere of 70 degrees Fahrenheit and 65 per cent relative humidity, plus or minus two degrees or two per cent (13).

Six pairs of hose from each lot were selected to be subjected to an actual wear test. One pair of hose from two different lots was worn by each individual participating in the test. After wearing one pair of hose during the normal day's activity, it was exchanged for the other pair. The pairs that had been worn were then washed in a home type washing machine using one of the leading washday detergents. These hose were dried at 200 degrees Fahrenheit in a drying chamber. After the second pair was worn, it was exchanged for the first pair and the same procedure repeated. Due to the lack of time available for this study, only 15 wearings on each pair of hose was possible. However, even this amount of wear revealed some very interesting results.

CHAPTER IV

DISCUSSION OF RESULTS

The results of the Uster evenness tests on all the material from the card sliver through the plied yarn are shown in Tables 9 through 20. The 100 per cent nylon card sliver was the most uneven while the 100 per cent Vicara was the least uneven. The various blends between these two extremes showed intermediate amounts of unevenness. However, as the processing continued through the various machines, the 100 per cent nylon tended to be the least uneven of all the lots. At the same time, the 100 per cent Vicara became the most uneven. The greatest spread of unevenness between the lots occurred in the roving. Here the 100 per cent Vicara showed a range variation of 65.85 per cent while the nylon showed a 43.45 per cent range variation. But when this roving was double creeled on the spinning frame the spread was narrowed to 96.51 per cent for 100 per cent Vicara and 89.40 per cent for 100 per cent nylon, a difference of only 7.11 per cent. Of course, when these yarns were plied the amount of unevenness dropped markedly giving a yarn which could be considered very even. The results of these evenness tests does not seem to indicate that the running quality was significantly different due to any adverse running conditions of any one lot.

The abrasion tests showed the 100 per cent Vicara fabric to have a very low resistance. The average cycles to destruction of this fabric was only 47.3. The tremendous effect of a small quantity

of nylon is shown by the abrasion resistance of the 75/25 Vicara/nylon where the cycles to destruction increased to approximately 12 times that of the 100 per cent Vicara lot. The following results were shown for the other lots, using the 100 per cent nylon lot for comparison. The 75/25 nylon/Vicara had 83.8 per cent of the resistance of 100 per cent nylon; 62.5/37.5 nylon/Vicara, 64.9 per cent; 50/50 nylon/Vicara, 57.3 per cent; 37.5/62.5 nylon/Vicara, 51.2 per cent; and, 25/75 nylon/Vicara, 42.9 per cent. It can be seen from these results that the presence of only 37.5 per cent nylon in the fabric gives over 51 per cent of the abrasion resistance of a 100 per cent nylon fabric.

The results of the bursting strength tests for each lot show that there was no appreciable difference between the bursting strength in the heel and in that of the toe, although in most lots the toe gave a slightly higher reading. For better comparison the heel and toe readings for each lot were averaged together. The presence of 25 per cent nylon in the fabric increased the bursting strength over the 100 per cent Vicara lot by 108 per cent. Again, using the 100 per cent nylon lot for comparison, the other lots showed the following percentage strengths: 75/25 nylon/Vicara, 90.6 per cent; 62.5/37.5 nylon/Vicara, 79.2 per cent; 50/50 nylon/Vicara, 63.8 per cent; 37.5/62.5 nylon/Vicara, 52.9 per cent; and, 25/75 nylon/Vicara, 45.7 per cent. Here, too, the presence of only 37.5 per cent nylon in the fabric gives over 52 per cent of the bursting strength of the 100 per cent nylon fabric.

The moisture content of the 100 per cent nylon lot was 3.6 per cent, rather low as expected. The 100 per cent Vicara lot showed a 9.5 per cent moisture content. Between these two extremes, the

Table 2. Summary Table for Abrasion, Bursting Strength and Moisture Content Tests.

Lot No.	Abrasion Resistance (Average Cycles to Destruction of Ten Samples)	Bursting Strength (Average Pounds to Burst of Twenty Samples)	Moisture Content (Average % of Two Samples)
1	47.3	45.8	9.5
2	563.5	95.5	7.3
3	672.2	110.7	6.8
4	752.2	133.4	6.2
5	853.2	165.5	5.4
6	1101.0	189.5	4.75
7	1314.0	209.1	3.6

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 62.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

moisture content increased steadily with the presence of more Vicara in the blend. The presence of 50 per cent Vicara in the blend increased the moisture content almost 75 per cent, while the presence of 37.5 per cent Vicara increased the moisture content exactly 50 per cent when compared with the 100 per cent nylon lot. The 62.5/37.5 Vicara/nylon lot showed a moisture content of 6.8 per cent, which is very close to that of cotton under the same conditions.

The results from the wear testing of the hose give a realistic evaluation for warmth, softness, abrasion and appearance. Each lot proved to have certain characteristics which are reproduced lot by lot as follows.

The 100 per cent Vicara hose did not stand up long under the harsh treatment that is naturally demanded of this article during wear. Within two wearings of this hose there were holes present in the toe and heel. However, even during its short life, it was proclaimed to be the softest and best feeling hose that the wearers had ever worn. The moisture absorption was superior and the fabric was very warm. There was no pilling of the Vicara but there was a fuzzy appearance to the fabric which was in part contributed to the low twist in the yarns.

The 75/25 Vicara/nylon hose showed a great improvement in abrasion resistance. The fabric had a very soft feeling, was warm and had superior moisture absorption. The Vicara in this hose gave the fabric a fuzzy appearance and the loose ends started to break off and wear away after about five wearings. After about eight wearings only the nylon remained in the areas of hardest abrasive wear. Only two pairs, which received the most abusive wear, were worn through and in both cases this occurred

in the toe of the hose after twelve wearings. There was some pilling of the nylon in the heel and toe.

The 62.5/37.5 Vicara/nylon hose showed much better wear characteristics than the previously mentioned fabrics. There were no cases where the hose were worn through. The loose Vicara ends began breaking off and wearing away after about eight wearings. The pairs which received the hardest wear showed that the Vicara wore away in the heel and toe after about twelve wearings, leaving the nylon, but this was not as prevalent as in the fabrics already mentioned. This fabric also showed a fuzzy appearance but of a lesser degree, and the pilling of the nylon was more noticeable in the heel and toe. The fabric had a very soft feel, was warm and had excellent moisture absorbency.

The results observed in the 50/50 Vicara/nylon fabric were very interesting. A marked change was noted in the wear qualities of this blend over the one last mentioned. There was no apparent abrasion or breaking off of the Vicara or the nylon fibers. The Vicara gave the fabric only a slight fuzzy appearance, but the increased amount of nylon contributed to greater pilling. The fabric had excellent moisture absorbency, was warm and was very soft. The overall appearance at the conclusion of the tests was very much improved over any of the fabrics mentioned thus far.

The 37.5/62.5 Vicara/nylon fabric showed absolutely no abrasion of either the Vicara or the nylon. There was no fuzzy appearance, but the nylon was pilled some. The fabric was soft but not to the degree of the fabrics with greater amounts of Vicara present. The fabric had a very good overall appearance at the conclusion of the testing.

Table 3. Summary Table for Wear Test Observations

Lot No.	Warmth	Softness	Abrasion Resistance	Moisture Absorption	Fuzzing
1	Superior	Superior	Very Poor	Superior	Very Noticeable
2	Superior	Superior	Poor	Superior	Very Noticeable
3	Excellent	Excellent	Fair	Excellent	Noticeable
4	Excellent	Excellent	Very Good	Very Good	Slight
5	Very Good	Very Good	Excellent	Good	Slight
6	Good	Good	Superior	Fair	None
7	Good	Fair	Superior	Poor	None

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 62.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

The 25/75 Vicara/nylon fabric showed similar characteristics to the 37.5/62.5 Vicara/nylon fabric. The only difference was a greater pilling tendency of the nylon.

The 100 per cent nylon fabric showed no abrasion, but the pilling was more prevalent and extended to all parts of the hose. This hose did not have the softness of the other fabrics and the moisture absorption was much less.

The pilling in all lots of fabrics occurred after less than five wearings. The greater the amount of nylon in the fabric, the greater was the pilling. The 100 per cent nylon and the 75/25 nylon/Vicara fabrics were pilled all over after about eight wearings, while the remaining lots pilled in the heel, toe and sole of the hose.

appearance of the fabric is the elimination of pilling. Pilling is the formation of bunches or balls of tangled fibers on the surface of a fabric due to the loose ends becoming tangled by any rubbing motion (14). This can be controlled somewhat by an appropriate combination of fabric variables such as yarn count, yarn twist, yarn ply, fabric construction and by the use of mechanical or chemical finishes.

Although the number of blends and the percentage blends used in this study give a representative sample, there are intermediate areas which could be explored advantageously.

APPENDIX

Table 4. Operating Data for Whitin Model T Picker

Type Beater	Rayon-Type
Kirschner beater speed (RPM)	840
Feed roll (RPM)	5.5
Beater to feed roll	0.1875"
Beats per inch	58
Feed roll diameter	2.5"
Sturtevant No. 4 Fan speed (RPM)	1725
Production pulley diameter	4"
Weight lap delivered	15 oz.
Atmospheric conditions	80° F., 65% R.H.

Table 5. Operating Data for Saco Lowell Roller Top Card

Doffer to cylinder	0.007"
Worker to cylinder	0.010"
Licker-in to cylinder	0.007"
Feed plate to licker-in	0.017"
Doffer comb to doffer	0.015"
Cylinder screen to cylinder (back)	0.029"
Cylinder screen to cylinder (middle)	0.058"
Cylinder screen to cylinder (front)	0.188"
Front knife plate (top)	0.034"
Front knife plate (bottom)	0.029"
Back knife plate (top and bottom)	0.029"
Licker-in screen to licker-in	0.029"
Mote knife to licker-in (top)	0.022"
Mote knife to locker-in (bottom)	0.017"
Stripper speed (RPM)	300
Worker speed (RPM)	8.25
Cylinder speed (RPM)	170
Doffer speed (RPM)	10
Licker-in speed (RPM)	200
Weight lap fed	15 oz.
Weight sliver delivered	60 gr.
Atmospheric conditions	80° F., 65% R.H.

Table 6. Operating Data for Whitin Model L2FS Drawing Frame

Roll Diameters	
Front roll	1.5"
Second roll	1.5"
Third roll	1.5"
Back roll	1.5"
Type Rolls	
All rolls metallic fluted	
Roll Settings (Center to Center)	
Front to second	1.625"
Second to third	1.750"
Third to back	2.000"
Front Roll Speed (RPM)	150
Weight Sliver Fed	60 gr.
Weight Sliver Delivered	60 gr.
Doublings	6
Total Draft	6
Atmospheric Conditions	80° F., 65% R.H.

Table 7. Operating Data for Saco Lowell Model FS-1
Long Draft Intermediate Roving Frame

Roll Diameters	
Front	1.125"
Middle	1.125"
Back	1.125"
Roll Settings	
Front to middle	2.0"
Middle to back	2.0"
Front Roll Speed (RPM)	140
Twist Multiplier	.95
Tension Gears	
For 100 per cent Vicara and all blends	53
For 100 per cent nylon	48
Lay Gear	42
Spindle Speed (RPM)	700
Weight Sliver Fed	60 gr.
Weight Hank Roving Delivered	1.85 h.r.
Atmospheric Conditions	80° F., 65% R.H.

Table 8. Operating Data for Saco Lowell Shaw System of Controlled Draft Model SS2 Spinning Frame

Roll Diameters	
Front roll	1.000"
Back roll	0.875"
Roll Settings (Center to Center)	
Front to middle	1.750"
Middle to back	2.000"
Spindle Speed (RPM)	6800
Front Roll Speed (RPM)	200
Traveler Sizes*	
For 100% nylon; 75/25 nylon/Vicara; 62.5/37.5 nylon/Vicara; 50/50 nylon/Vicara	No. 12
For 37.5/62.5 nylon/Vicara; 25/75 nylon/Vicara	No. 10
For 100% Vicara	No. 3
Atmospheric Conditions	80° F. 65% R.H.

*Traveler Sizes
No. 12- 10 travelers weigh 33 grains
No. 10- 10 travelers weigh 26 grains
No. 3- 10 travelers weigh 12 grains

Table 9. Results of Uster Evenness Test on Card Sliver-Per Cent Range Variation Per Yard

Yard No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	9	9	17	13	13	12	13
2	10	10	8	13	11	13	10
3	10	11	12	12	14	11	14
4	11	10	9	12	13	13	13
5	11	10	11	15	11	11	16
6	10	11	13	13	16	8	16
7	10	12	12	12	13	12	12
8	13	9	11	14	11	15	11
9	12	15	15	10	10	13	15
10	9	15	11	11	11	14	11
11	13	13	13	12	12	12	12
12	6	8	12	12	13	12	12
13	11	12	8	11	12	12	12
14	16	11	13	14	14	10	13
15	6	9	12	12	16	11	12
16	11	7	11	10	9	10	11
17	12	14	11	14	15	10	14
18	10	13	14	13	11	10	12
19	9	11	12	12	12	10	13
20	9	10	8	11	13	12	13
21	8	10	10	14	9	13	11
22	11	14	9	10	13	9	14
23	11	10	16	8	16	11	13
24	10	13	13	10	9	10	12
25	10	13	12	11	14	10	15
26	10	10	13	14	12	11	11
27	12	10	10	12	11	16	10
28	15	15	12	9	14	13	8
29	10	12	15	12	10	13	13
30	12	12	13	10	13	16	12
Average	10.57	11.30	11.87	11.87	12.37	11.77	12.40

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 62.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 10. Results of Uster Evenness Test on First Drawing Sliver-Per Cent Range Variation Per Yard

Yard No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	15	21	19	17	18	19	12
2	17	19	18	23	20	20	16
3	23	19	22	16	22	23	19
4	21	21	17	21	20	27	23
5	18	17	15	26	27	18	14
6	14	21	21	24	17	24	20
7	17	18	17	19	21	21	14
8	16	21	26	14	24	17	18
9	21	25	24	19	23	16	14
10	20	22	19	19	20	23	15
11	25	20	19	21	22	21	15
12	17	19	18	13	16	18	11
13	15	21	21	17	23	17	19
14	19	19	20	20	17	18	21
15	18	24	24	16	27	21	17
16	15	20	19	16	22	15	17
17	18	21	20	20	21	16	15
18	18	21	19	19	18	26	17
19	15	18	22	21	18	20	19
20	18	21	17	20	23	21	17
21	23	17	23	18	22	15	21
22	21	18	19	19	21	16	16
23	14	22	18	23	25	20	21
24	13	15	18	19	20	21	16
25	15	25	22	29	20	19	18
26	19	19	16	14	16	16	18
27	18	20	25	18	22	19	16
28	23	19	18	18	17	21	10
29	22	14	24	21	19	21	14
30	14	20	20	20	17	22	19
Average	18.07	20.23	20.00	19.33	20.60	19.37	16.73

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 62.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 11. Results of Uster Evenness Test on Second Drawing Sliver-Per Cent Range Variation Per Yard

Yard No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	18	20	20	24	20	18	18
2	33	22	24	33	24	23	22
3	26	20	26	34	23	30	20
4	25	24	23	28	22	30	21
5	32	27	28	25	23	21	27
6	25	27	30	21	25	25	22
7	19	21	22	22	19	21	22
8	34	28	21	39	26	20	19
9	19	23	18	28	15	22	15
10	28	28	24	28	24	25	14
11	20	28	28	32	30	19	19
12	28	19	28	22	25	23	15
13	17	18	31	18	23	27	16
14	28	25	19	21	25	20	20
15	20	26	18	25	30	26	22
16	25	24	21	23	21	20	18
17	24	31	16	22	23	18	19
18	21	23	31	20	21	27	28
19	26	17	19	34	23	21	25
20	25	29	20	29	25	27	14
21	28	34	25	24	18	28	17
22	24	26	20	30	24	25	21
23	28	26	24	24	29	23	25
24	23	23	21	19	21	23	20
25	17	23	23	23	16	22	16
26	24	22	20	25	19	23	18
27	33	17	26	21	20	30	15
28	22	19	22	26	25	21	22
29	20	22	23	30	25	25	25
30	23	25	20	22	22	26	15
Average	24.50	23.90	23.03	25.73	22.87	23.63	19.67

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 62.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 12. Results of Uster Evenness Test on Roving
Per Cent Range Variation Per Yard

Yard No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	54	72	53	47	47	49	38
2	72	68	50	78	46	61	48
3	50	54	71	68	46	42	48
4	90	72	64	72	56	57	42
5	71	82	54	58	38	63	40
6	69	69	61	65	60	47	46
7	62	57	57	63	52	56	47
8	70	65	68	68	48	58	34
9	80	64	54	60	57	36	48
10	69	58	68	49	45	42	30
11	79	48	58	68	52	52	50
12	73	59	63	74	44	39	35
13	59	66	48	57	46	47	39
14	59	78	66	64	47	46	52
15	55	58	54	86	51	52	40
16	60	57	55	61	51	52	61
17	75	82	62	45	56	42	38
18	57	75	55	60	64	61	55
19	57	79	72	60	52	60	34
20	56	37	64	59	56	62	44
Average	65.85	65.00	59.85	63.10	50.70	51.20	43.45

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 62.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 13. Results of Uster Evenness Test on 100% Vicara Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	56	76	74
2	110	86	78
3	74	82	82
4	90	84	100
5	118	96	92
6	72	106	80
7	104	104	132
8	126	100	120
9	114	80	84
10	108	120	106
11	104	114	80
12	86	122	76
13	124	110	64
14	92	94	112
15	84	112	88
16	138	86	80
17	94	106	140
18	130	92	92
19	100	74	68
20	78	118	90
21	90	70	100
22	108	118	82
23	118	84	80
24	116	100	90
25	82	96	92
26	76	108	110
27	134	110	88
28	106	136	102
29	84	88	70
30	94	56	96

Average for 3 bobbins-96.51

Table 14. Results of Uster Evenness Test on 75/25 Vicara/Nylon Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	94	92	86
2	70	90	78
3	82	110	74
4	98	88	92
5	110	92	70
6	90	92	94
7	122	76	82
8	84	84	64
9	88	82	80
10	96	80	78
11	84	96	92
12	82	94	56
13	90	84	98
14	96	100	96
15	78	112	92
16	78	122	104
17	112	84	116
18	78	112	62
19	94	106	110
20	114	76	82
21	68	88	76
22	106	112	76
23	94	108	88
24	90	108	96
25	100	84	94
26	102	96	92
27	100	86	118
28	62	78	142
29	68	126	82
30	66	90	114

Average for 3 bobbins-91.42

Table 15. Results of Uster Evenness Test on 62.5/37.5 Vicara/Nylon Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	120	116	106
2	82	74	78
3	78	78	92
4	88	88	74
5	112	102	82
6	94	74	94
7	100	80	100
8	100	68	64
9	96	90	104
10	100	94	88
11	92	92	74
12	92	92	100
13	70	108	94
14	86	92	110
15	62	100	82
16	98	108	110
17	130	90	86
18	92	128	72
19	80	84	78
20	84	78	94
21	106	82	72
22	112	74	94
23	102	87	70
24	78	106	80
25	54	112	98
26	86	70	118
27	98	104	110
28	104	72	94
29	64	90	124
30	70	106	104

Average for 3 bobbins-91.24

Table 16. Results of Uster Evenness Test on
50/50 Vicara/Nylon Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	74	84	102
2	96	84	100
3	68	92	84
4	66	92	74
5	90	86	106
6	104	112	88
7	98	120	96
8	102	122	100
9	82	116	60
10	126	102	80
11	74	84	92
12	102	112	88
13	78	90	110
14	112	88	94
15	94	94	102
16	64	100	92
17	102	110	142
18	80	82	92
19	96	88	66
20	94	88	88
21	76	80	78
22	64	84	104
23	102	92	100
24	74	82	80
25	98	90	78
26	72	84	82
27	126	78	120
28	116	90	66
29	64	96	76
30	80	86	78

Average for 3 bobbins-91.09

Table 17. Results of Uster Evenness Test on 37.5/62.5 Vicara/Nylon Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	92	108	68
2	82	76	86
3	98	84	108
4	80	74	66
5	84	94	70
6	98	108	70
7	96	96	114
8	112	80	100
9	100	90	76
10	78	62	102
11	68	84	100
12	86	118	122
13	62	80	82
14	74	80	84
15	76	72	110
16	106	88	108
17	70	80	88
18	120	72	40
19	106	68	84
20	88	82	68
21	80	88	100
22	80	96	92
23	92	98	84
24	80	68	108
25	70	100	86
26	98	132	88
27	70	90	132
28	100	74	112
29	84	114	106
30	90	88	108

Average for 3 bobbins-89.18

Table 18. Results of Uster Evenness Test on 25/75 Vicara/Nylon Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	76	112	88
2	118	104	88
3	86	72	68
4	94	86	102
5	74	74	86
6	70	96	98
7	104	78	104
8	100	118	100
9	84	84	76
10	96	80	114
11	82	82	76
12	96	118	88
13	86	114	134
14	70	114	86
15	92	84	94
16	82	58	98
17	74	86	90
18	78	100	82
19	76	92	68
20	98	98	86
21	76	84	84
22	96	90	104
23	66	88	70
24	92	82	82
25	94	86	78
26	78	92	74
27	74	122	88
28	82	100	86
29	74	92	78
30	116	82	110

Average for 3 bobbins-89.47

Table 19. Results of Uster Evenness Test on 100% Nylon Spun Yarn-Per Cent Range Variation Per Yard

Yard No.	Bobbin 1	Bobbin 2	Bobbin 3
1	102	78	94
2	92	108	86
3	66	76	82
4	92	104	94
5	90	94	86
6	90	82	74
7	100	100	94
8	90	82	106
9	88	74	96
10	122	72	94
11	86	78	94
12	92	70	76
13	82	78	66
14	100	128	86
15	94	68	80
16	72	66	92
17	90	68	106
18	88	92	116
19	94	76	84
20	102	92	100
21	120	78	98
22	94	94	110
23	96	78	86
24	98	90	92
25	86	76	88
26	98	118	90
27	88	94	78
28	102	76	94
29	70	92	80
30	70	88	98

Average for 3 bobbins-89.40

Table 20. Results of Uster Evenness Test on Plied Yarn- Per Cent Range Variation Per Yard

Yard No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	82	58	74	60	50	60	48
2	54	54	60	64	50	72	52
3	86	42	60	72	54	68	54
4	58	54	66	54	58	68	44
5	72	50	82	50	66	82	64
6	62	62	58	64	44	64	68
7	66	54	64	70	64	66	64
8	78	40	56	80	62	80	60
9	86	56	48	52	58	56	50
10	68	70	70	64	92	70	50
11	42	56	68	62	46	82	62
12	48	68	54	66	52	56	66
13	72	54	68	108	52	48	64
14	76	58	74	56	54	50	60
15	67	70	66	74	58	46	46
16	60	46	68	50	48	50	64
17	76	46	48	64	84	56	80
18	66	58	72	56	70	74	50
19	68	50	72	50	54	60	52
20	80	64	74	54	56	72	64
21	76	54	56	72	54	52	58
22	46	40	62	62	54	56	70
23	80	60	60	54	64	56	52
24	88	46	70	58	72	46	54
25	64	80	64	70	72	48	36
26	92	66	68	72	58	60	56
27	68	76	52	56	78	68	66
28	72	56	62	48	82	62	54
29	58	64	56	50	66	50	60
30	72	78	70	54	54	80	50
Average	69.20	57.67	63.87	62.13	60.87	62.00	57.27

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 52.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 21. Results of Stoll Abrasion Tests on Finished Hose-Cycles to Destruction

Sample No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	41	842	1153	1086	942	2853	1774
2	25	621	914	650	786	733	1072
3	34	589	483	460	920	759	1490
4	46	342	635	569	687	1032	812
5	44	854	630	1236	764	1312	1730
6	45	310	355	1070	602	1064	1894
7	79	390	1060	232	1232	747	1459
8	61	526	520	1229	1108	956	1067
9	60	922	789	391	665	854	1026
10	39	230	193	589	826	700	826
Average	47.3	563.5	672.2	752.2	853.2	1101	1314

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 52.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 22. Results of Bursting Strength Tests in Heel and Toe of Finished Hose-Pounds to Burst

Heel

Sample No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	54	101	112	136	138	185	211
2	54	77	95	122	148	214	186
3	44	92	107	134	174	177	204
4	50	100	100	131	151	188	224
5	59	87	97	136	152	179	194
6	44	105	117	125	179	204	214
7	45	99	101	137	171	181	193
8	41	97	110	154	144	189	213
9	42	89	113	141	158	191	219
10	49	101	110	123	183	176	205
Average	48.2	94.8	106.2	133.9	159.8	188.4	206.6

Toe

Sample No.	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
1	39	89	111	132	186	210	219
2	45	110	110	126	168	190	219
3	49	105	119	119	155	178	185
4	38	86	118	132	192	178	184
5	46	97	120	126	163	194	222
6	49	90	115	151	196	204	215
7	45	100	112	143	162	186	221
8	43	98	113	156	149	211	229
9	39	89	123	116	171	167	219
10	41	97	111	127	170	189	202
Average	43.4	96.1	115.2	132.8	171.2	190.7	211.5

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 52.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

Table 23. Results of Brabender Moisture Content Test on Finished Hose-Per Cent Moisture Content

Lot No.	Sample 1	Sample 2	Average
1	9.4	9.6	9.5
2	7.4	7.2	7.3
3	6.7	6.9	6.8
4	6.2	6.2	6.2
5	5.2	5.6	5.4
6	4.8	4.7	4.75
7	3.5	3.7	3.6

Lot 1- 100% Vicara
Lot 2- 75/25 Vicara/nylon
Lot 3- 52.5/37.5 Vicara/nylon
Lot 4- 50/50 Vicara/nylon
Lot 5- 37.5/62.5 Vicara/nylon
Lot 6- 25/75 Vicara/nylon
Lot 7- 100% nylon

BIBLIOGRAPHY

1. Karrh, John H., "Vicara - Its Progress of Development in the Blend", Rayon and Synthetic Textiles, 31, February 1950, p. 65.

2. Goldberg, Julius B., "The 'Whys and Wherefores' of Blends", Canadian Textile Journal, 71, No. 1, January 15, 1954, p. 66.

3. Yeates, Jesse F., Jr., "Two Fibers Often Better Than One", Rayon and Synthetic Textiles, 32, September, 1951, p. 64.

4. Quig, J. B., and Dennison, R. W., "Functional Properties of Synthetics", Industrial and Engineering Chemistry, 44, No. 9, September, 1952, p. 2180.

5. Ibid, p. 2176.

6. Mauer, Leonard and Wechsler, Harry, "Modern Textiles Handbook", Modern Textiles, 33, December, 1952, pp. 41, 43.

7. Quig, Op. cit., p. 2176.

8. Wildermuth, Grace R., "Vicara - A New Synthetic Fibre", Canadian Textile Journal, 66, No. 4, April 29, 1949, p. 40.

9. Karrh, John H., "Vicara - A Progress Report on This New Blending Fiber", Rayon and Synthetic Textiles, 31, July 1950, p. 36.

10. American Society for Testing Materials, ASTM Standards on Textile Materials, Philadelphia, 1954, pp. 169-172.

11. Ibid, p. 158.

12. American Society for Testing Materials, ASTM Standards on Textile Materials, Philadelphia, 1952, p. 337.

13. Federal Specifications CCC-T-191b 15 May 1951, Textile Test Methods, Washington.

14. E. I. du Pont de Nemours and Co., Inc., "Determination of the Pilling Tendency of Woven Fabrics", Bulletin X-46 (December 1955).